GEOTECHNICAL EVALUATION REPORT

CARTER ROAD SLIDE
CLEVELAND, OHIO

SME Project Number: 076822.27
March 29, 2019

SME
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Kirtland, OH 44094-8501
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March 29, 2019

Mr. Thomas Boyer, PE
Design Section Chief
601 Lakeside Room 518
Cleveland, Ohio 44114

Via E-mail: *tboyer@city.cleveland.oh.us*

RE: Geotechnical Evaluation Report
Carter Road Slide
Cleveland, Ohio
SME Project No. 076822.27

Dear Mr. Boyer:

We have completed the geotechnical evaluation for the Carter Road Slide in Cleveland, Ohio. The attached report presents the results of our field and laboratory testing, stability analysis, interpretation of the data, and our preliminary stability recommendations.

We appreciate the opportunity to work with you on this project. If you have questions, please call.

Sincerely,

SME

Brendan P. Lieske, PE
Project Engineer

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1. INTRODUCTION

This report presents the results of the geotechnical evaluation for the Carter Road Slide in Cleveland, Ohio. We performed this evaluation in general accordance with our scope and budget emailed to the City of Cleveland on November 12, 2018, and authorized by Tom Boyer, Design Section Chief Division of Engineering and Construction, as Work Task #27 on November 13, 2018.

SME received the following information which was used in the evaluation and preparation of this report:

- Portions of a geotechnical report by BBC&M, dated 2008 for the Columbus Road Lift Bridge.
- A Geotechnical Report for the Scranton Road/Carter Road Improvements, prepared by Solar Testing Laboratories and dated July 9, 2015.
- A Slope Stability Evaluation for Carter Road Subdivision No. 1, prepared by Solar Testing Laboratories and dated July 15, 2016.
- Boring Logs for the Lake Link Trail, prepared by Timmerman Geotechnical Group and dated September 2013.
- Soil boring logs for Lake Link Trail Phase 1 by Solar Testing Laboratories dated 2016.
- A Geotechnical Subsurface Exploration Report for the Carter Road Improvement Project, prepared by PSI and dated May 22, 2014.
- A Geotechnical Subsurface Exploration Report for the Scranton Road Improvement Project, prepared by PSI and dated May 28, 2014.
- A Geotechnical Exploration Report for the Sheet Pile Wall for the Scranton/Carter Road Rehabilitation project, prepared by Solar Testing Laboratories and dated August 20, 2015.

Boring information from Solar's July 9, 2015, Geotechnical Report and their July 15, 2016, Slope Stability Evaluation along with BBC&M's boring logs were incorporated with information from our study to develop the subsurface profile used in our analysis. To provide clarity and ease of reading, we have reproduced the relevant Solar and BBCM boring logs into the SME log format. The locations of the relevant Solar and BBC&M borings are shown on the attached Boring Location Plan and slope stability profile.

1.1 SITE CONDITIONS AND PROJECT DESCRIPTION

The project site is located in the area of Carter Road east of the Columbus Road lift bridge. A slide has occurred between the north curb line of Carter Road and the bank of the Cuyahoga River. We have illustrated the approximate location of the visible scarp on our boring location plan. Carter Road sits below a slope to the south and above the river. The top of the upper slope has a surface elevation of 685 feet. Carter road is near elevation 611 feet and the river's edge is near elevation 569 feet. The depth of the river is roughly estimated at 28 feet. This results in a total slope height of about 144 feet. Carter road is about 70 feet above the river bottom.

The portion of land between the road and river carries a Cleveland Metroparks multipurpose trail. The trail is part of the Metroparks long range plan to connect the existing trails from the south, up through the Irishtown Bend area, connecting to Lake Erie, and is a key feature in the trail system. There is also a storm water outlet that collects surface waters from Carter Road and water from a hydrodynamic separator intended to treat storm water from future development along the south side of Carter Road. The storm water discharge point has been protected with rock channel protection to minimize erosion.

Our goal for this geotechnical evaluation is to better define the geology beneath Carter Road and perform a preliminary slope stability analysis to help determine the cause of the slide, which can ultimately be used to design a repair solution that will stabilize the slope.

2. EVALUATION PROCEDURES

2.1 FIELD EXPLORATION

We completed two Standard Penetration Test (SPT) borings at the site between November 19 and 27, 2018. B-1 was extended to a final depth of 164 feet below existing grade, which included 20 feet of rock coring. B-2 was extended to a final depth 80 feet. In addition to split-barrel samples, we also collected seven thin-walled Shelby tube samples. A slope inclinometer tube was set into the bedrock at a depth of 160 feet below existing grade within the borehole at B-1.

SME determined the number, depths, and locations of the borings. We marked the boring locations by measuring offsets from existing site features referencing them to known monument pins in the street. We measured the relative ground surface elevation at each boring location, as well as multiple points along the slope to provide data to develop our slope stability profile. We referenced one of the monument pins on Carter Road as a benchmark. The approximate benchmark, ground surface elevations, and boring locations are shown on the attached *Boring Location Plan*.

The borings were drilled and sampled in general accordance with ASTM Standards. The borehole at B-2 was backfilled with a bentonite and cement slurry.

2.2 LABORATORY TESTING

Samples from the borings were taken to our laboratory, where they were visually classified in general accordance with ASTM D-2488. We determined the moisture contents on portions of the soil samples obtained and performed hand penetrometer and torvane shear tests on selected cohesive samples. We also performed three direct shear tests on selected Shelby tube samples and two uniaxial compressive strength tests on selected rock core samples. The rock cores have been photographed and are presented in Appendix A.

The boring logs and laboratory test results are included in Appendix A. Explanations of symbols and terms used on the boring logs are provided on the Boring Log Terminology sheet included in Appendix A.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

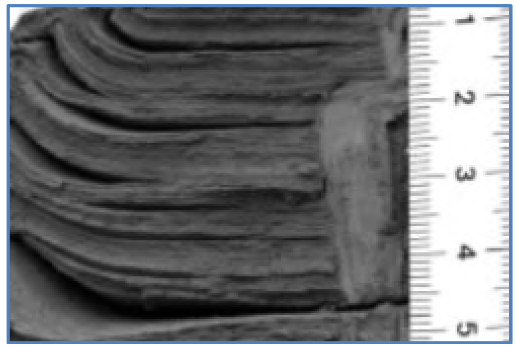
The soil profile consists of fill over predominantly sands and silts (Alluvium and terrace deposits) over interbedded deposits of harder silts and clays (glacial tills). Shale bedrock is encountered near elevation 467 feet, approximately 142 feet below the surface of Carter Road.

Within our borings, we encountered 5 inches of topsoil at the surface followed by 14 ½ feet (B-2) to 28 feet (B-1) of fill. The fill consists of sand with varying amount of gravel, clay, bricks, slag, concrete, cinders, and organics. Below the fill, we encountered very loose to loose sands and silts to about 43 feet (elevation 567 feet) at B-1 and 30 feet (elevation 580 feet) at B-2.

> Below the sands and silts, we encountered a medium stiff to stiff layer of varved (see description and photographs below) silty/lean clay, which we've identified as the weak (low shear strength) layer within this subsurface profile. This layer extends from a depth of about 42 to 61 feet (elevation 567 to 548 feet). Direct shear test results indicate that soils within this layer have a post-peak friction angle of about 17°, which is low. Our slope stability analyses indicate that this layer is the likely failure plane and our inclinometer readings, also presented in the Appendix A, confirmed movement within this layer. The condition at Carter Road is very similar, if not the same as, the failing slope conditions at the Irishtown Bend where this weak lacustrine clay layer also exists.

Photographs of Varved Clay – Scale in Millimeters

Carter Road Sample



Typical Image of Varved Clay

Varved clays are lacustrine deposits (soil deposited through water onto lake bottoms) of thinly bedded layers of silt and clay. Most of the lacustrine deposits in our area are post glacial deposits that were formed after the glaciers left our area. They are typically found over the top of glacial till deposits as is the case at Carter Road. The layering occurs between seasons when lakes goes from unfrozen to frozen and the water becomes calmer beneath this ice. The silt particles are larger and heavier and settle to the lake bottom when the water is open or unfrozen. Once the lake freezes, and the water turbulence calms down, the smaller clay particles settle to the bottom. Each silt/clay layer is like the ring of a tree and represent one season. The thicknesses of the layers vary depending on sediment load and how long the lake is frozen over. The layering in this case does not necessarily equal one year of time but only one cycle of freezing. Not all lacustrine clays are varved. Portions of the weak lacustrine clay layers sampled in our borings did not show varving.

At a depth of about 61 feet (elevation 548 feet, below the weak clay layer), we encountered glacial till consisting of very stiff to hard lean/silty clay and dense silt. At a depth of about 142 feet (elevation 467 feet), we encountered medium to moderately hard shale.

The nearby uphill Solar boring logs indicate a similar profile in the zones that overlap our borings. Above our borings, the logs show sandy fill from the surface to a depth ranging from 6½ to 23½ feet. Below the fill, these borings show loose or better sands and silts to their termination depths. The deepest subsurface information from the Solar borings ends at elevation 584 feet which is above the identified weak clay layer in our borings.

The soil profile included on the boring logs is a generalized description of the conditions encountered. The stratification depths shown on the boring logs indicate a zone of transition from one soil type to another and do not show exact depths of change from one soil type to another. The soil descriptions are based on visual classification of the soils encountered. Soil conditions may vary between or away from the boring locations.

3.2 GROUNDWATER CONDITIONS

Groundwater was not observed in our bore holes during our field exploration once we switched from hollow-stem augers to mud rotary drilling methods. For our slope stability profile, we used groundwater information from the Solar boring logs along with our moisture content test results and visual observations of the split-barrel and thin-wall Shelby tube samples which indicate groundwater between elevation 594 feet and 607 feet. Hydrostatic groundwater levels should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater conditions indicated by the borings represent conditions at the time the readings were taken. The groundwater levels at the time of construction may vary from those conditions noted on the boring logs.

4. ANALYSIS AND RECOMMENDATIONS

4.1 INCLINOMETER READINGS

As previously stated, a slope inclinometer tube was installed at B-1 for long term monitoring of the slope in the failed area. Inclinometer readings from this slope tube help define the slip plane within the slide, the rate of movement, and can be used to validate our model of the slope. On December 7, 2018, we performed a set of two baseline readings of this inclinometer tube. Since this baseline reading, we have returned to the site twice for additional readings, on December 21, 2018, and on February 6, 2019. A cumulative displacement plot of these readings is included in Appendix A. We have budgeted for two additional inclinometer readings in the future. If visible movement of the slope is observed, please notify SME and we will perform an inclinometer reading right away. If no movement is observed in the near future, we recommend waiting until March or April 2019 to perform the next reading.

Inclinometer readings at B-1 indicate displacement in the positive A-axis direction (toward the river) at depth range of about 50 to 60 feet below existing grade (elevation 560 to 550 feet). This displacement aligns with the weak clay layer that we identified in our borings and direct shear tests.

4.2 SLOPE STABILITY ANALYSIS

To develop the surface profile for our slope stability analysis, we measured the relative ground surface elevation at each boring location, as well as multiple points along the slope. We combined the results of our survey with the Cuyahoga County Topographic map to develop our slope profile shown on our *Boring Location Plan*. We used soils information from our borings and the relevant Solar borings to develop the subsurface profile for our analysis. Soil properties used in our slope stability analysis are listed in Table 1.

Table 1. Stability Analysis Soil Properties

Soil Description	Unit Weight (lbs/ft^3)	Cohesion (psf)	Friction Angle (deg.)
Fill	128	0	31
Very Loose Sand/Silt	138	0	35
Medium Dense Silt (Silt 1)	140*	0	35*
Medium Stiff Varved, Lean/Silty Clay (CL 1)	122*	0	16.6*
Stiff Lean Clay (CL 2)	130*	0	29*
Very Stiff Lean Clay (Till 1)	138	0	31
Dense Silt (Silt 2)	142	0	35
Hard Lean Clay (Till 2)	143	0	32
Shale	145	1500	40

*Indicates properties determined by laboratory testing. All other properties are estimated.

Our evaluation indicates that failures on this slope are occurring within the weak lacustrine clay layer between elevations 580 feet and 548 feet. This clay layer does not possess sufficient strength to resist movement of the slope. This slope is also located on the outside bank of a bend in the Cuyahoga River, which is typically exposed to a significant amount of erosion due to the hydraulics of the river and the turbulence generated by passing and turning ships. **The river is essentially eroding the toe of the slope at the low strength layer, leaving the slope susceptible to failure.** There is a failed bulk head along the river bank that is contributing to the slope movement.

We completed stability analyses using the residual shear strength of the weak clay layer, since we believe this to be more representative of the existing conditions. By adjusting the limits of our analysis, we evaluated failures at the toe of the slope (where the scarp is presently forming), the middle of the slope, and globally from the top of the slope. The results of these analyses are included in Appendix A, titled "Down Slope_Non-circular", "Mid Slope_Non-circular", and "Top Slope_Non-circular", respectively. The results of each of these analyses indicates a non-circular failure with a Factor of Safety (FS) of about 1, which indicates a critical slope. By standard convention for stability, the FS should be at least 1.3 where there are no structures on or near the slope, and 1.5 where there are structures.

4.3 PRELIMINARY SLOPE REPAIR RECOMMENDATIONS

Based upon the results of our slope analysis, the depth of the failure plane below Carter Road, and the intention to focus solely on protecting Carter Road and the Cleveland Metroparks multipurpose trail, the following stabilization approaches that should be considered are presented below. North of and south of Carter Road, additional localized stabilization will likely be required by the land owners if they wish to prevent future slope failures. **Without supplemental stabilization work, these slopes have a high probability of failure. The approaches described below will not prevent failures from occurring north or south of Carter Road, but are intended to stabilize Carter Road and the Cleveland Metroparks trail.**

4.3.1 APPROACH 1 – RIVER'S EDGE BULKHEAD

The stabilizing effort for the slope begins at the river's edge where nearby bulk head structures have failed over time. Because of the depth of the failure zone, 42 to 61 feet below Carter Road (see the Carter Road Section presented in Appendix A), a deep wall system toed into the underlying very stiff clay soils and tied back near its top by drilling anchors, will most likely be required. Such systems will stabilize the instability of Carter Road and could also improve the FS for the slopes above Carter Road. The wall height at the river's edge would most likely be selected to help flatten the angle of the slope below Carter Road. This approach would preserve the most usable land space available for the Metroparks' trail, provided a reasonable slope angle can be achieved.

The slope between the river and the bike path is currently at angle of about 1.7H: 1V, or steeper. Based on the estimated shear strength of these soils, this slope could exhibit additional failures, even after installing a bulkhead. To increase stability, the slope should be regraded to a flatter angle or reinforced if the steeper angle needs to be preserved. This could be accomplished by raising the top of the bulkhead, moving the crest of the slope closer to the bike path (installing a guard rail for safety), or a combination of systems.

4.3.2 APPROACH 2 – RETAINGING WALL

We understand that the property between the river and the Metroparks' trail is privately owned; therefore, a river's edge approach may not be possible without the cooperation of the current property owner. A second approach would be to construct a wall, similar to the bulkhead, but higher up the slope, just north of the Metroparks' trail. This would eliminate the need to work along the river bank but would do nothing to protect the shoreline from further erosion. The soil between the high wall and the river bank would be sacrificial. This solution could be used to adjust the bend in the river making it slightly more accommodating to the turning of larger ships. Similar to the bulkhead, this approach would likely consist of a deep wall system toed into the very stiff clay soils below the weak clay layer. Tiebacks anchors would likely be required for this wall too, but would be need to be more robust to account for the steeper installation angle if they must remain completely within the City's right of way.

4.3.3 CONSIDERATIONS FOR BOTH APPROACHES

The bulkhead or retaining wall should extend from the Columbus Road Bridge east to where the bike path crosses Carter Road. The exact limits and depth of the bulkhead should be determined during the evaluation phase. Preliminarily, we have included an approximate location of proposed bulkhead and retaining wall on the attached *Boring Location Plan*. We anticipate that sheet-piling, tangential drilled piers, or modified H-piling systems for the bulkhead or retaining wall need to be driven or drilled at least 20 feet into the underlying till layer, bearing at or below elevation 510 feet. This would result in sheet-piling or wall sections in excess of 75 feet for the bulkhead and 100 feet for the retaining wall. Both approaches would likely require tiebacks, installed at a downward angle to anchor within the glacial till layer or possibly the shale bedrock if higher capacities are needed, below elevation 530 feet.

The storm water discharge point, described in Section 1.1, is currently protected with a rock channel to minimize erosion. Both stabilization approaches will need to include maintaining this location. This may consist of a concrete headwall or buttress.

4.4 RECOMMENDED NEXT STEPS

We recommend that the City of Cleveland initiates a design evaluation phase to develop plan concepts for the slope repair. This should include determining the following design information:

- The required embedment depth of sheet-piling or piers for the bulkhead wall or retaining wall.
- The appropriate length of the bulkhead wall or retaining wall.
- The required embedment depth for anchoring the tiebacks.
- Recommendations for regrading the slope between the bulkhead and the bike path, including the required slope angle to result in a FS of 1.3 to 1.5.

Prepared by:

STATE OF OHIO
BRENDAN PATRICK LIESKE
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REGISTERED PROFESSIONAL ENGINEER

Brendan P. Lieske, PE
Project Engineer

Reviewed by:

STATE OF OHIO
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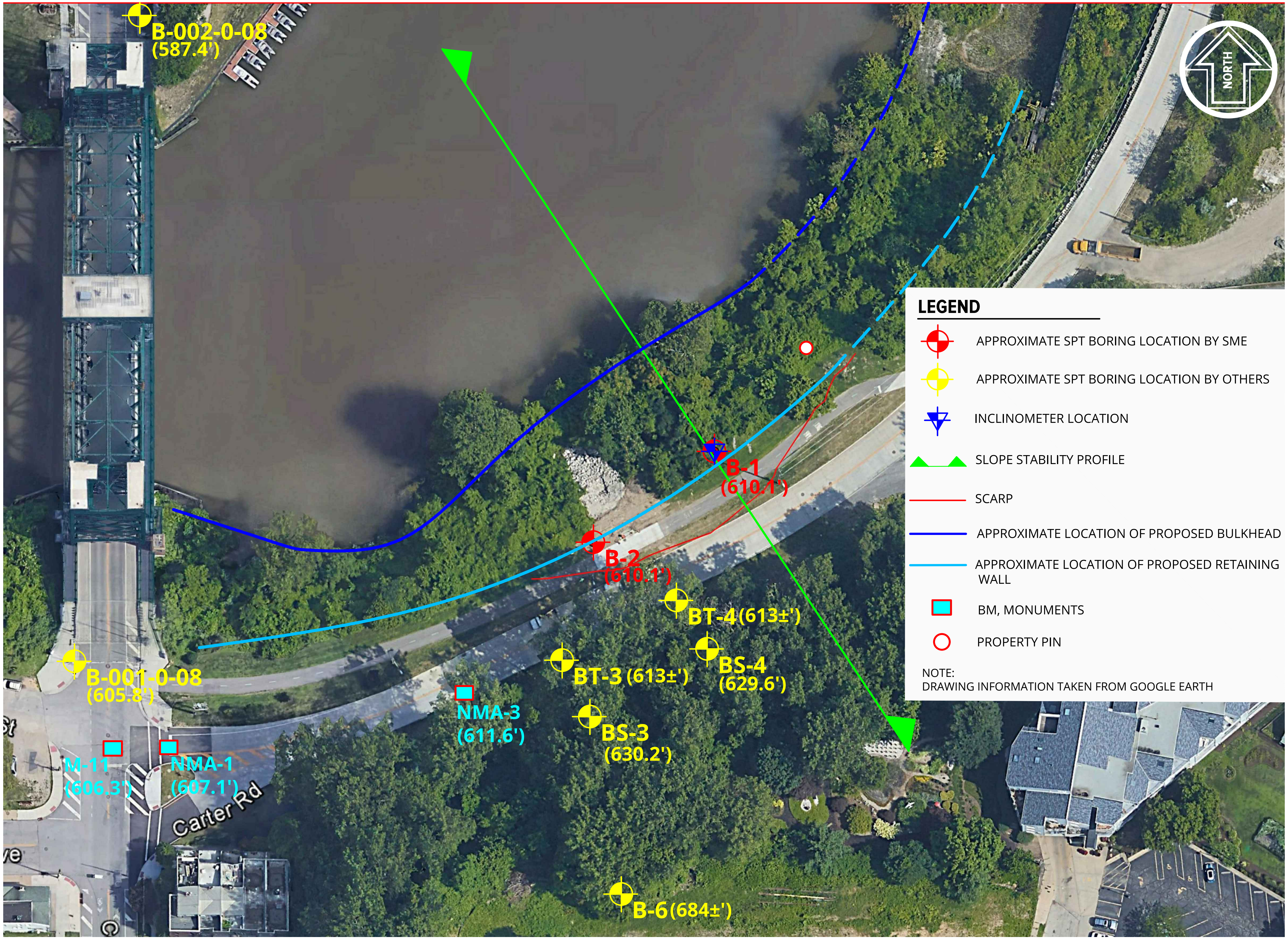
John E. Dingeldein, PE
Principal Consultant

APPENDIX A

BORING LOCATION PLAN
BORING LOG TERMINOLOGY
BORING LOGS BY SME
BORING LOGS BY OTHERS
ROCK CORE PHOTOGRAPH LOG
ROCK CORE COMPRESSIVE STRENGTH TEST RESULTS
DIRECT SHEAR TEST RESULTS
SLOPE STABILITY PROFILE
SLOPE STABILITY ANALYSIS
INCLINOMETER PLOTS



SME

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Project
CARTER ROAD SLIDE GEOTECHNICAL ANALYSIS

Project Location
CARTER ROAD
CLEVELAND, OH

Sheet Name
BORING LOCATION PLAN

No.	Revision Date
1	02/13/2019
2	03/26/2019
3	3/27/2019

Date: 03/26/2019

CADD: JF

CHKD: BPL

Scale: NTS

Project: 076822.27

Figure No. 1

DRAWING NOTE: SCALE DEPICTED IS MEANT FOR 11" X 17" AND WILL SCALE INCORRECTLY IF PRINTED ON ANY OTHER SIZE MEDIA

FILE LOCATION:

PLOT DATE:

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

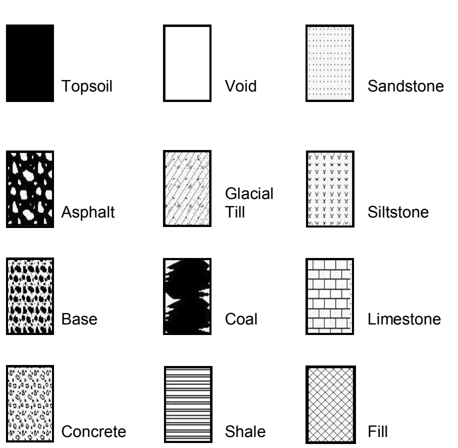
COARSE-GRAINED SOIL (more than 50% of material is larger than No. 200 sieve size.)

Major division	Subgroup	Symbol	Description
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravel (Less than 5% fines)	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)	GM	Silty gravel; gravel-sand-silt mixtures
		GC	Clayey gravel; gravel-sand-clay mixtures
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sand (Less than 5% fines)	SW	Well-graded sand; sand-gravel mixtures, little or no fines
		SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)	SM	Silty sand; sand-silt-gravel mixtures
		SC	Clayey sand; sand–clay-gravel mixtures

FINE-GRAINED SOIL (50% or more of material is smaller than No. 200 sieve size)

Major division	Symbol	Description
SILT AND CLAY Liquid limit less than 50%	ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
	CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
	OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater	MH	Inorganic silt of high plasticity, elastic silt
	CH	Inorganic clay of high plasticity, fat clay
	OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL	PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS



LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \dfrac{D_{60}}{D_{10}}$ greater than 4; $C_C = \dfrac{D_{30}^{\ 2}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \dfrac{D_{60}}{D_{10}}$ greater than 6; $C_C = \dfrac{D_{30}^{\ 2}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent……………………….……..GW, GP, SW, SP
More than 12 percent………………………..…….GM, GC, SM, SC
5 to 12 percent……………...……..Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

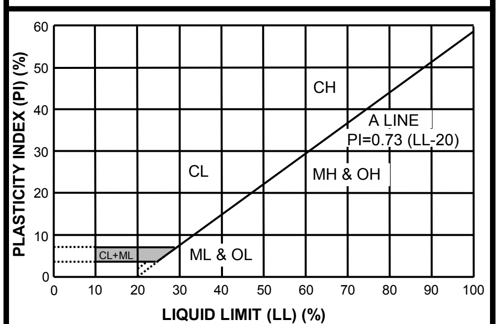
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)
- GM-GC (CLAYEY SILTY GRAVEL or CLAYEY SILTY GRAVEL with Sand)

PARTICLE SIZES

Boulders	-	Greater than 12 inches
Cobbles	-	3 inches to 12 inches
Gravel- Coarse	-	3/4 inches to 3 inches
Fine	-	No. 4 to 3/4 inches
Sand- Coarse	-	No. 10 to No. 4
Medium	-	No. 40 to No. 10
Fine	-	No. 200 to No. 40
Silt and Clay	-	Less than (0.0074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)
- OL/OH (ORGANIC SILT or ORGANIC CLAY)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressure Meter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	N-Value (Blows per foot)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	50 to 80
Extremely Dense	Over 80

Cohesive Soils

Consistency	N-Value (Blows per foot)	Undrained Shear Strength (kips/ft^2)
Very Soft	0 - 2	0.25 or less
Soft	2 - 4	0.25 to 0.50
Medium	4 - 8	0.50 to 1.0
Stiff	8 - 15	1.0 to 2.0
Very Stiff	15 - 30	2.0 to 4.0
Hard	> 30	4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted.

PROJECT NAME: Carter Road Slide Geotechnical Analysis
PROJECT NUMBER: 076822.27
CLIENT: City of Cleveland
PROJECT LOCATION: Cleveland, Ohio
DATE STARTED: 11/20/18
COMPLETED: 11/27/18
BORING METHOD: 4-1/4" Hollow Stem Auger and Mud Rotary
DRILLER: RH/RM
RIG NO.: 525-CME550X-ATV
LOGGED BY: JF
CHECKED BY: JED

SURFACE ELEVATION: 610.1 FT

Depth (ft)	Profile Description	Elevation (ft)
0.4	5 Inches of TOPSOIL	609.7
3.0	FILL - Sand with Concrete and Wood Fragments - Dark Brown and Gray - Damp	607.1
28.0	FILL - Sand with Gravel, Clay, Slag, Cinders, and Organics - Dark Brown and Black - Damp	582.1
33.0	Fine SAND with Clay - Trace Gravel - Brown - Most to Wet - Very Loose to Loose (SP-SC)	577.1
38.0	SANDY SILT - Clay Seams - Brown - Wet - Very Loose (ML)	572.1
43.0	SILTY SAND with Gravel - Brown - Very Loose to Loose (SM)	567.1
48.0	SILTY CLAY - Trace Organics - Gray - Stiff (CL)	562.1
	LEAN CLAY - Gray - Varved - Medium Stiff (CL)	

Sample Type/No.	Recovery Length (inches)	Blows per Six Inches	N-Value	Moisture (%)	Shear Strength (KSF)
SB1	3	8 3 3	6	26	
SB2	5	3 3 3	6	24	
SB3	6	3 3 2	5	20	
SB4	16	19 20 20	40	>>60	
SB5	10	6 7 6	13	30	
SB6	9	3 4 3	7	19	
SB7	8	4 3 2	5	15	
SB8	12	2 2 2	4	15	
SB9	18	1 1 1	2	21	
3ST10	24				
SB11	18	1 2 2	4	19	
SB12	18	2 3 6	9	25	Hand pene.
3ST13	15				
SB14	14	1 3	8	30	0.7 (Torvane shear)

Legend: ▽ HAND PENE. ⊠ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) ╳ VANE SHEAR (REM) ⊕ TRIAXIAL (UU)

DRY DENSITY (pcf) -- ■ ; MOISTURE & ATTERBERG LIMITS (%) PL MC LL ; N-VALUE -- ○ ; REMARKS

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Inclinometer

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Groundwater not observed due to mud rotary drilling method.

(Continued Next Page)

PROJECT NAME: Carter Road Slide Geotechnical Analysis | **PROJECT NUMBER:** 076822.27

CLIENT: City of Cleveland | **PROJECT LOCATION:** Cleveland, Ohio

SURFACE ELEVATION: 610.1 FT

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION
50.0 – 58.0	560 – 552.1	LEAN CLAY - Gray - Varved - Medium Stiff (CL) *(continued)*
58.0 – 61.8	552.1 – 548.4	LEAN CLAY - Gray - Stiff (CL)
61.8 – 81.8	548.4 – 528.4	LEAN CLAY - Sand Partings - Gray - Varved - Very Stiff (CL)
81.8 – 116.8	528.4 – 493.4	LEAN CLAY with Sand - Trace Gravel - Gray - Very Stiff (CL)

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)
(continued)		5			
3ST15	24				
SB16	18	1-1-4	5	28	0.7 (Torvane)
3ST17	24				
SB18	18	3-6-6	12	22	
SB19	18	6-11-10	21	21	
SB20	18	7-10-12	22	24	
3ST21	24				
SB22	11	5-5-11	16	21	
SB23	18	7-8-15	23	22	
3ST24	24				
SB25	7	10-12-16	28	18	
SB26	18	8-12-17	29	19	
SB27	18	9-16-16	32	18	
SB28	18	9-10-14	24	20	
SB29	18	8-10-14	24	21	
3ST30	24				
SB31	9	5-8-9	17	25	
SB32	18	8-11-12	23	24	

REMARKS

(Continued Next Page)

BORING B-1

PROJECT NAME: Carter Road Slide Geotechnical Analysis
PROJECT NUMBER: 076822.27
CLIENT: City of Cleveland
PROJECT LOCATION: Cleveland, Ohio

SURFACE ELEVATION: 610.1 FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)	REMARKS
		SILT - Gray - Wet - Dense (ML)	SB33	18	15 18 20	38	24		
487.1	123.0								
		LEAN CLAY with Sand, Gravel, and Shale Fragments - Gray - Hard (CL)	SB34	18	15 20 30	50	12	▽	
			SB35	18	14 25 33	58	17	4.5+ ▽	
477.1	133.0								
		SILTY CLAY - Gray - Hard (CL/ML)	SB36	18	14 21 30	51	25	▽	
473.1	137.0								
		Sandy LEAN CLAY with Shale Fragments - Greenish Gray - Hard (CL)	SB37	18	16 18 30	48	15		
467.6	142.5								
		SHALE - Greenish Gray - Medium Hard	SB38	3	50/3"				
466.1	144.0								
		SHALE - Gray to Black - Slightly Weathered - Highly to Moderately Fractured - Medium to Moderately Hard	RC39	115.2					Uniaxial compressive strength = 1,260 psi
			RC40	120					Uniaxial compressive strength = 830 psi
446.1	164.0								

END OF BORING AT 164.0 FEET.

Legend: DRY DENSITY (pcf) -- ■ (90 100 110 120); N-VALUE -- ○ (10 20 30 40); MOISTURE & ATTERBERG LIMITS (%) PL MC LL (10 20 30 40); ▽ HAND PENE.; ⊠ TORVANE SHEAR; ○ UNC.COMP.; ⊡ VANE SHEAR (PK); × VANE SHEAR (REM); ⊕ TRIAXIAL (UU); SHEAR STRENGTH (KSF) 1 2 3 4

Elevation scale: 490, 480, 470, 460, 450, 440, 430. Depth scale: 120, 130, 140, 150, 160, 170, 180.

BORING B-2

PROJECT NAME: Carter Road Slide Geotechnical Analysis **PROJECT NUMBER:** 076822.27

CLIENT: City of Cleveland **PROJECT LOCATION:** Cleveland, Ohio

DATE STARTED: 11/19/18 **COMPLETED:** 11/19/18 **BORING METHOD:** 4-1/4" Hollow Stem Auger and Mud Rotary

DRILLER: RH/RM **RIG NO.:** 525-CME550X-ATV **LOGGED BY:** JF **CHECKED BY:** JED

SURFACE ELEVATION: 610.1 FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)	REMARKS
609.7	0.4	5 Inches of TOPSOIL							
595.6	14.5	FILL - Sand with Gravel, Clay, Bricks, Concrete, Slag and Cinders - Dark Brown - Damp	SB1	7	6 4 3	7	16		
			SB2	12	4 6 7	13	20		
			SB3	6	50/6"				
			SB4	7	4 2 2	4	19		
			SB5	12	3 2 2	4	14		
587.1	23.0	Fine to Coarse SAND with Clay- Trace Gravel - Brown - Moist to Wet - Very Loose (SP-SC)	SB6	12	1 1 1	2	16		
580.1	30.0	Fine to Coarse SAND - Brown - Wet - Very Loose (SP)	SB7	10	1 1 1	2			
			SB8	18	1 2 2	4	11		
573.4	36.8	SILTY CLAY - Gray - Soft to Medium Stiff (CL/ML)	SB9	6	1 2 2	4	24	▽	
568.1	42.0	SILTY CLAY - Gray - Stiff (CL/ML)	SB10	9	5 6 8	14	20	▽	
561.6	48.5	SILTY CLAY - Trace Organics - Gray - Medium Stiff to Stiff (CL/ML)	SB11	18	2 3 5	8	27	▽	
			SB12	18	4 5	10	29	⊠ 0.6	

Legend: DRY DENSITY (pcf) -- ■ (90 100 110 120); MOISTURE & ATTERBERG LIMITS (%) PL MC LL; N-VALUE -- ○; ▽ HAND PENE.; ⊠ TORVANE SHEAR; ○ UNC.COMP.; ⊡ VANE SHEAR (PK); × VANE SHEAR (REM); ⊕ TRIAXIAL (UU)

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Bentonite & Cement

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Groundwater not observed due to mud rotary drilling method.

(Continued Next Page)

SME

BORING B-2

PROJECT NAME: Carter Road Slide Geotechnical Analysis **PROJECT NUMBER:** 076822.27

CLIENT: City of Cleveland **PROJECT LOCATION:** Cleveland, Ohio

SURFACE ELEVATION: 610.1 FT

Legend – N-VALUE -- ○; DRY DENSITY (pcf) -- ■ (90, 100, 110, 120); MOISTURE & ATTERBERG LIMITS (%) PL –◆– MC – LL (10, 20, 30, 40); SHEAR STRENGTH (KSF) (1, 2, 3, 4): ▽ HAND PENE., ⊠ TORVANE SHEAR, ○ UNC.COMP., ⊡ VANE SHEAR (PK), ✕ VANE SHEAR (REM), ◈ TRIAXIAL (UU)

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)	REMARKS
560	50	LEAN CLAY - Little Organics - Gray - Varved - Stiff (CL) *(continued)*			5				
			SB13	18	2 4 5	9	29	0.4 (Torvane)	
553.9	56.3	LEAN CLAY - Gray - Medium Stiff (CL)	SB14	18	2 2 4	6	30	0.6 (Torvane)	
550	60								
548.9	61.3	LEAN CLAY - Gray - Stiff (CL)	SB15	18	1 4 5	9	31	0.5 (Torvane)	
			SB16	18	5 7 8	15	23	0.8 (Torvane)	
540	70								
538.1	72.0	SILTY CLAY to CLAYEY SILT - Gray - Very Stiff (CL/ML)	SB17	18	8 12 18	30	22	▽	
533.6	76.5	LEAN CLAY - Trace Gravel - Gray - Very Stiff (CL)	SB18	18	7 12 15	27	20	▽	
530.1 / 530	80.0	END OF BORING AT 80.0 FEET.							

Elevation scale: 520 (90), 510 (100), 500 (110)

BORING BS-3

SME

SOLAR

PROJECT NAME: Lake Link Homes Phase 1 **PROJECT NUMBER:** S016375

CLIENT: Lake Link LLC **PROJECT LOCATION:** Carter Road, Cleveland, Ohio

DATE STARTED: 6/3/16 **COMPLETED:** 6/3/16 **BORING METHOD:** Hollow Stem Auger

DRILLER: P. Simpson **RIG NO.:** **LOGGED BY:** Sam S. **CHECKED BY:**

SURFACE ELEVATION: 632± FT

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	REMARKS
0.0–10.0	632.0–622.0	FILL: Brown SAND, trace concrete, slag, brick fragments, rock fragments (Moist)	SB1	7	20 50/1"		
			SB2	18	6 11 10	21	
			SB3	18	8 22 20	42	Concrete
			SB4	18	7 4 3	7	
10.0–12.0	622.0–620.0	FILL: Brown fine SAND, trace gravel (Moist)					
12.0–16.0	620.0–616.0	FILL: Brown SILTY CLAY, little brick fragments, rocks fragments (Moist)	SB5	18	5 4 3	7	
16.0–19.0	616.0–613.0	FILL: Brown SAND, trace gravel (Moist)	SB6	8	50 50/4"		
19.0–27.0	613.0–605.0	Loose brown coarse SAND (Moist)	SB7	18	2 2 2	4	
27.0–35.0	605.0–597.0	Medium dense brown SILTY SAND (Wet)	SB8	18	6 6 5	11	
			SB9	18	7 8 8	16	

END OF BORING AT 35.0 FEET.

DRY DENSITY (pcf) -- ■ 90 100 110 120; MOISTURE & ATTERBERG LIMITS (%) PL MC LL 10 20 30 40; N-VALUE -- ○ 10 20 30 40; SHEAR STRENGTH (KSF) 1 2 3 4: ▽ HAND PENE. ⊠ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) ✕ VANE SHEAR (REM) ✧ TRIAXIAL (UU)

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	26.0	606.0
CAVE-IN OF BOREHOLE AT:	23.0	609.0
BACKFILL METHOD:		

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Reproduced Solar Testing Laboratories Broing Log

BORING BS-4

SOLAR

PROJECT NAME: Lake Link Homes Phase 1
PROJECT NUMBER: S016375
CLIENT: Lake Link LLC
PROJECT LOCATION: Carter Road, Cleveland, Ohio
DATE STARTED: 6/3/16
COMPLETED: 6/3/16
BORING METHOD: Hollow Stem Auger
DRILLER: P. Simpson
RIG NO.:
LOGGED BY: Sam S.
CHECKED BY:

SURFACE ELEVATION: 631± FT

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	REMARKS
0.0–6.0	FILL: Black and brown SILTY SAND, trace wood, rock fragments (Moist)	625.0	SB1	18	32 9 6	15	
			SB2	10	8 10 13	23	
6.0–20.0	FILL: Black to brown SAND, trace concrete, rock fragments, brick fragments (Moist)	611.0	SB3	18	11 15 20	35	
			SB4	18	9 12 15	27	
			SB5	18	12 11 11	22	
			SB6	18	4 2 2	4	Trace gravel, cinders, slag
20.0–34.0	Loose to medium dense brown fine SAND (Moist to Wet)	597.0	SB7	18	3 2 5	7	
			SB8	18	4 5 6	11	
							Color change to gray
34.0–35.0	Stiff gray SILTY CLAY (Wet)	596.0	SB9	18	4 3 6	9	

END OF BORING AT 35.0 FEET.

DRY DENSITY (pcf) -- ■ 90 100 110 120; MOISTURE & ATTERBERG LIMITS (%) PL MC LL 10 20 30 40; ▽ HAND PENE. ⊠ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) ✕ VANE SHEAR (REM) ⊕ TRIAXIAL (UU) SHEAR STRENGTH (KSF) 1 2 3 4; N-VALUE -- ○ 10 20 30 40

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	25.0	606.0
CAVE-IN OF BOREHOLE AT:	23.5	607.5
BACKFILL METHOD:		

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Reproduced Solar Testing Laboratories Broing Log

BORING BT-3

SOLAR

SME

PROJECT NAME: Lake Link Homes Phase 1

PROJECT NUMBER: S016375

CLIENT: Lake Link LLC

PROJECT LOCATION: Carter Road, Cleveland, Ohio

DATE STARTED: 6/3/16 **COMPLETED:** 6/3/16

BORING METHOD: Hollow Stem Auger

DRILLER: P. Simpson **RIG NO.:**

LOGGED BY: Sam S. **CHECKED BY:**

SURFACE ELEVATION: 613± FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE -- O	DRY DENSITY (pcf) -- ■ / MOISTURE & ATTERBERG LIMITS (%) PL MC LL	SHEAR STRENGTH (KSF)	REMARKS
613.0 – 606.5	0 – 6.5	FILL: Brown SILTY SAND, trace rock fragments (Moist)	SB1	18	6 7 7	14			
			SB2	10	1 0 1	1			Some coal, wood
606.5 – 598.0	6.5 – 15.0	Dense brown SILTY SAND, trace rock fragments (Moist)	SB3	18	3 14 10	24			
			SB4	18	1 2 3	5			
			SB5	18	4 7 5	12			Trace CLAY

END OF BORING AT 15.0 FEET.

Legend: ▽ HAND PENE. ⊠ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) ✕ VANE SHEAR (REM) ⊕ TRIAXIAL (UU)

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	10.0	603.0

BACKFILL METHOD:

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Reproduced Solar Testing Laboratories Broing Log

BORING BT-4

PAGE 1 OF 1

SOLAR

SME

PROJECT NAME: Lake Link Homes Phase 1
PROJECT NUMBER: S016375
CLIENT: Lake Link LLC
PROJECT LOCATION: Carter Road, Cleveland, Ohio

DATE STARTED: 6/3/16 **COMPLETED:** 6/3/16 **BORING METHOD:** Hollow Stem Auger
DRILLER: P. Simpson **RIG NO.:** **LOGGED BY:** Sam S. **CHECKED BY:**

SURFACE ELEVATION: 613± FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	REMARKS
613 to 606.5	0 to 6.5	FILL: Black to brown SILTY SAND, trace rock fragments (Moist)	SB1		8 8 9	17	
			SB2	18	3 4 3	7	Trace cinders
606.5 to 598.0	6.5 to 15.0	Medium dense to loose brown fine to coarse SAND, trace gravel (Moist)	SB3	18	10 6 2	8	
			SB4	18	2 2 2	4	
			SB5	15	3 3 3	6	

END OF BORING AT 15.0 FEET.

Column headings also include: SYMBOLIC PROFILE; DRY DENSITY (pcf) -- ■ (90 100 110 120); MOISTURE & ATTERBERG LIMITS (%) PL MC LL (10 20 30 40); N-VALUE -- ○ (10 20 30 40); ▽ HAND PENE., ⊠ TORVANE SHEAR, ○ UNC.COMP., ⊡ VANE SHEAR (PK), × VANE SHEAR (REM), ⌖ TRIAXIAL (UU), SHEAR STRENGTH (KSF) (1 2 3 4).

Elevation scale: 610, 605, 600, 595, 590, 585, 580. Depth scale: 0, 5, 10, 15, 20, 25, 30, 35.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

	DEPTH (FT)	ELEV (FT)
CAVE-IN OF BOREHOLE AT:	10.0	603.0

BACKFILL METHOD:

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Reproduced Solar Testing Laboratories Broing Log

SME

BORING B-6

SOLAR

PROJECT NAME: Scranton/Carter Road Rehabilitation
PROJECT NUMBER: A14585x10
CLIENT: Machael Baker Corporation
PROJECT LOCATION: Cleveland, Ohio

DATE STARTED: 12/18/14 **COMPLETED:** 12/18/14
BORING METHOD: 2 1/4" Hollow Stem Augers
DRILLER: D. Simpson **RIG NO.:**
LOGGED BY: S. Canning **CHECKED BY:**

SURFACE ELEVATION: 684 FT

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION
0 – 13.5	684 – 670.5	FILL: Brown SAND, little gravel, trace clay, brick fragments, sandstone frgaments, slag, black organics (wood fragments) (Damp)
13.5 – 23.5	670.5 – 660.5	FILL: Black SAND and crushed oil-covered LIMESTONE (Damp)
23.5 – 28.5	660.5 – 655.5	POSSIBLE FILL: Medium dense brown COARSE SAND, little gravel, trace sandstone fragments, slag (Damp)
28.5 – 33.5	655.5 – 650.5	Loose brown SILTY SAND, trace gravel, clay (Damp)
33.5 –	650.5 –	

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	REMARKS
SB1	9	6 6 4 1	10		
SB2	7	2 3 6	9		
SB3	5	3 3 8	11		
SB4	5	6 2 4	6		
SB5	18	23 41 42	83		
SB6	17	28 48 45	93		
SB7	9	10 4 4	8		Petroleum Odor
SB8	14	2 2 2	4	22	
SB9	12	2 5 8	13		

DRY DENSITY (pcf) -- ■ 90 100 110 120
MOISTURE & ATTERBERG LIMITS (%) PL MC LL 10 20 30 40
SHEAR STRENGTH (KSF) 1 2 3 4: ▽ HAND PENE. ⊠ TORVANE SHEAR ○ UNC.COMP. ⊡ VANE SHEAR (PK) ✕ VANE SHEAR (REM) ⊕ TRIAXIAL (UU)

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	90.0	594.0
CAVE-IN OF BOREHOLE AT:	46.0	638.0
BACKFILL METHOD:		

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Reproduced Solar Testing Laboratories Broing Log

(Continued Next Page)

BORING B-6

SOLAR

SME

PROJECT NAME: Scranton/Carter Road Rehabilitation **PROJECT NUMBER:** A14585x10

CLIENT: Machael Baker Corporation **PROJECT LOCATION:** Cleveland, Ohio

SURFACE ELEVATION: 684 FT

Legend: DRY DENSITY (pcf) -- ■ (90, 100, 110, 120); MOISTURE & ATTERBERG LIMITS (%) PL, MC, LL (10, 20, 30, 40); N-VALUE -- ○ (10, 20, 30, 40); ▽ HAND PENE.; ⊠ TORVANE SHEAR; ○ UNC.COMP.; ⊡ VANE SHEAR (PK); ✕ VANE SHEAR (REM); ◈ TRIAXIAL (UU); SHEAR STRENGTH (KSF) (1, 2, 3, 4)

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION
35 – 43.5	– 640.5	Medium dense brown COARSE SAND and GRAVEL, trace silt, clay (Damp) *(continued)*
43.5 – 53.5	640.5 – 630.5	Medium dense brown FINE SAND, trace silt, clay (Damp)
53.5 – 58.5	630.5 – 625.5	Medium dense brown SILTY SAND, trace clay (Damp)
58.5 –	625.5 –	Medium dense to dense gray SILT, little sand, clay, trace back organics (A-4b) (Damp)

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	REMARKS
SB10	12	6 7 8	15	4	
SB11	15	7 7 9	16		
SB12	18	5 9 11	20	10	
SB13	18	5 5 8	13	24	
SB14	17	3 5 5	10	20	
SB15	18	7 7 15	22	21	Non-plastic
SB16	18	22 32 40	72		
SB17	18	15 17 19	36		
SB18	18	9 12 15	27	20	

(Continued Next Page)

BORING B-6

SOLAR

SME

PROJECT NAME: Scranton/Carter Road Rehabilitation **PROJECT NUMBER:** A14585x10

CLIENT: Machael Baker Corporation **PROJECT LOCATION:** Cleveland, Ohio

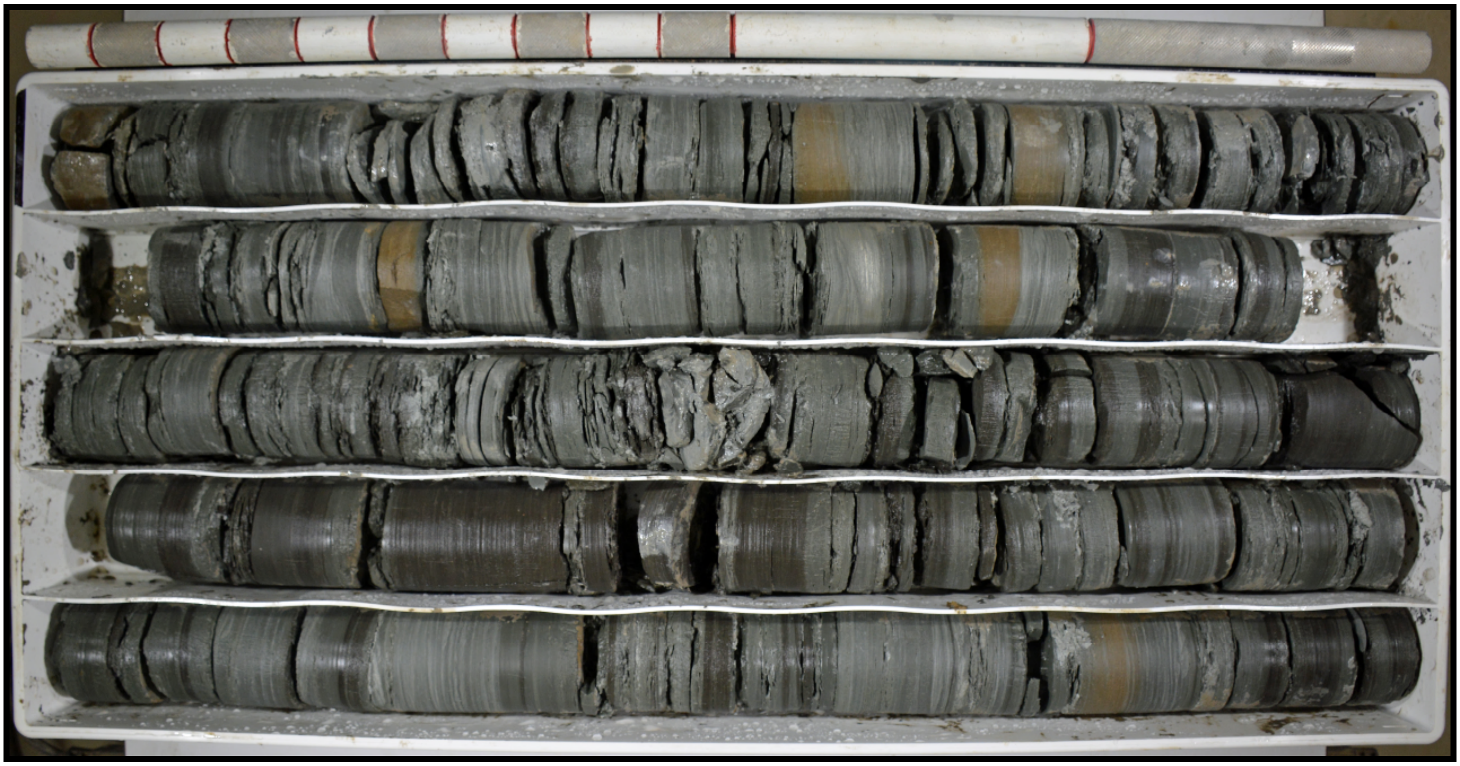
SURFACE ELEVATION: 684 FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE -- O	MOISTURE & ATTERBERG LIMITS (%) / DRY DENSITY (pcf)	SHEAR STRENGTH (KSF)	REMARKS
600.5	83.5	Dense gray FINE SAND and SILT, trace black organics (Damp)	SB19	18	7 12 16	28	18		
595.5	88.5	Very stiff gray SILT, little clay (Moist)	SB20	18	5 6 10	16	21		
			SB21	18	5 7 9	16			
584.0	100.0		SB22		4 8 10	18			

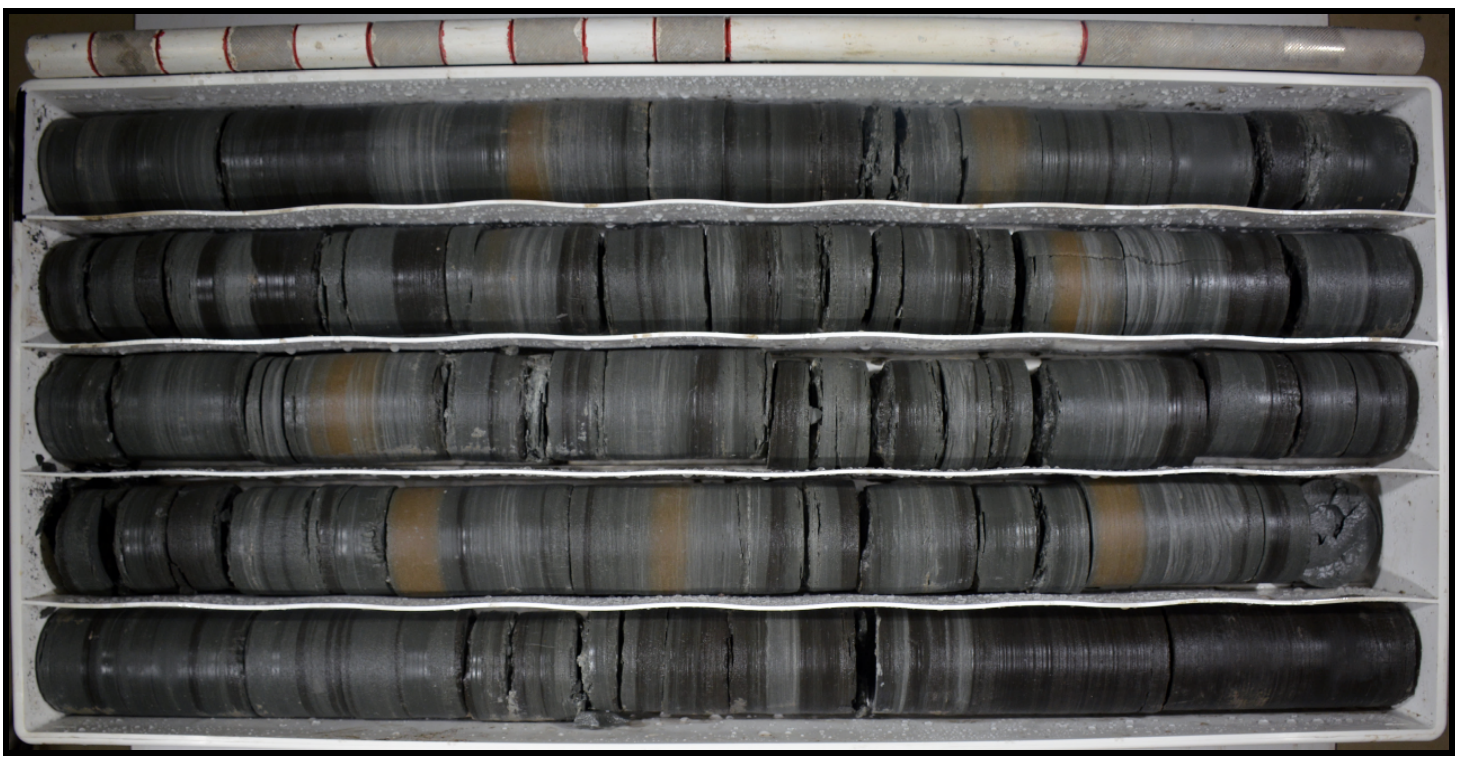
END OF BORING AT 100.0 FEET.

Legend (Shear Strength): ▽ HAND PENE.; ⊠ TORVANE SHEAR; O UNC.COMP.; ⊡ VANE SHEAR (PK); X VANE SHEAR (REM); ⊕ TRIAXIAL (UU)

Moisture & Atterberg Limits: PL, MC, LL



B-1, RUN 1: NWL CORE 144.0 TO 154.0 FEET.



B-1, RUN 2: NWL CORE 154.0 TO 164.0 FEET.

9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

Compressive Strength of Intact Rock Core Specimens
ASTM D7012

PROJECT	Carter Road Slide
LOCATION	Cleveland, Ohio
DATE	December 11, 2018
PROJECT #	076822.27
CLIENT	City of Cleveland

SAMPLE	**1**	**2**	**3**	**4**
				
SAMPLE LOCATION	B-1; 154'	B-1; 164'		
DATE TESTED	August 17, 2016	August 17, 2016		
ORIGINAL LENGTH, in	---	---		
CAPPED LENGTH, in	4.39	4.36		
DIAMETER, in	1.97	1.95		
AREA, sq. in.	3.05	2.99		
LOAD AT FAILURE, lbs.	3,845	2,470		
GROSS UNIT STRESS, psi	1,261	827		
LENGTH/DIAMETER RATIO	2.2	2.2		
CORRECTION FACTOR	1.0	1.0		
UNIT STRESS CORRECTED, psi	**1260**	**830**		
MOISTURE CONDITION WHEN TESTED	MOIST	MOIST		

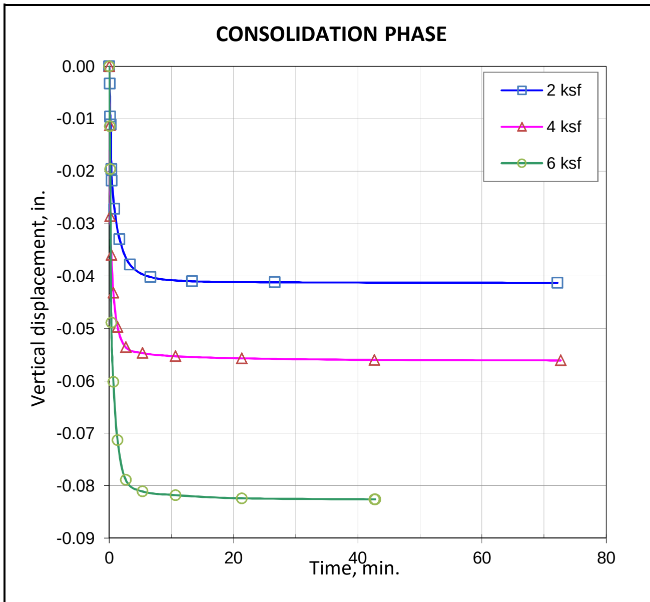
REMARKS: Correction factor used from ASTM C39, section 8.2
Samples tested do not meet the requirements for sample preparation per ASTM D4543

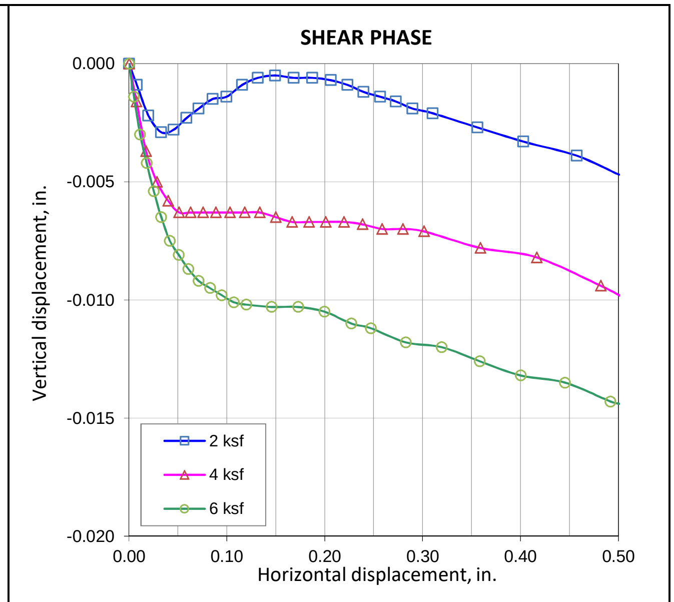
9375 Chillicothe Road, Kirtland, Ohio 44094-8501
p: 440-256-6500, f: 440-256-6500

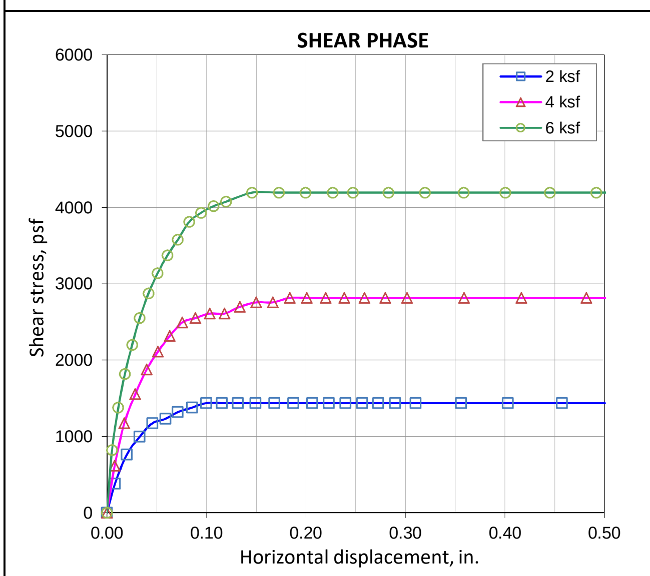
DIRECT SHEAR TEST, ASTM D3080

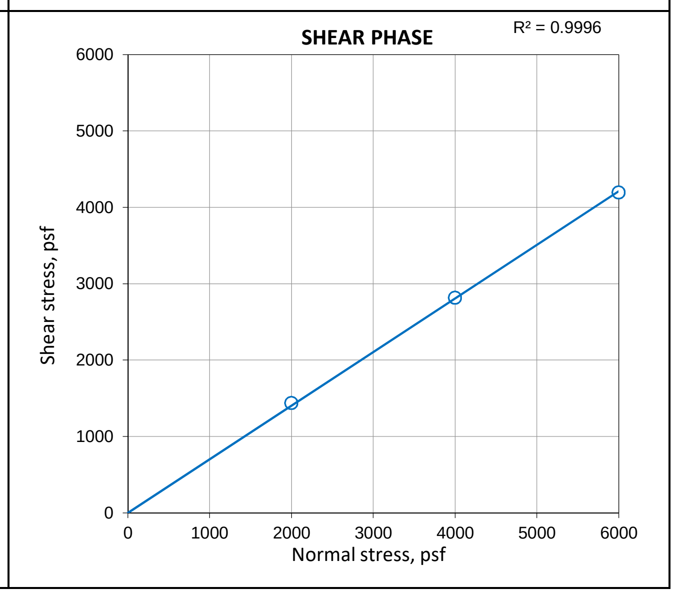
PROJECT: Carter Road Landslide
LOCATION: Cleveland, Ohio
PROJECT #: 076822.27
CLIENT: City of Cleveland
TEST DATE(S): 1/2/2019

SAMPLE #: ST
SAMPLE LOCATION: B-1; 36.5' - 38.5'
SAMPLE DESCRIPTION: Brown SANDY SILT
SOIL STRUCTURE: Undisturbed
SHEAR DEVICE: Tecnotest
TEST CONDITIONS: Shear box saturated
TECHNICIAN: SM









	Sample Parameters		
Normal stress (psf):	2000	4000	6000
Thickness (in):	0.999		
Diameter (in):	2.500		
Dry mass sample (gr):	151.8	151.3	151.1
Initial moisture content (%):	17.2	17.3	18.5
Initial wet density (pcf):	137.7	137.5	138.7
Initial dry density (pcf):	117.5	117.2	117.0
Final moisture content (%):	15.3	15.1	16.7
Final wet density (pcf):	143.3	145.4	153.0
Final dry density (pcf):	124.3	126.4	131.0

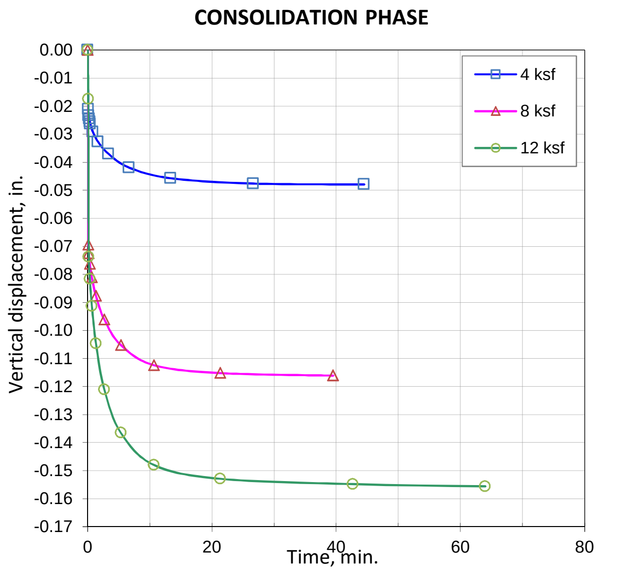
	Test Results		
Normal stress (psf):	2000	4000	6000
	CONSOLIDATION PHASE		
Final vertical displacement (in):	-0.041	-0.056	-0.083
Duration consolidation (min):	72.2	72.7	42.8
	SHEAR PHASE		
Peak shear stress (psf):	1438	2816	4195
Horizontal displacement (in):	0.093	0.175	0.146
Shear rate (mm/min):	0.010	0.011	0.008
Duration of test (min):	885	855	1140
ϕ (deg):	35.1		
Cohesion (psf):	0		

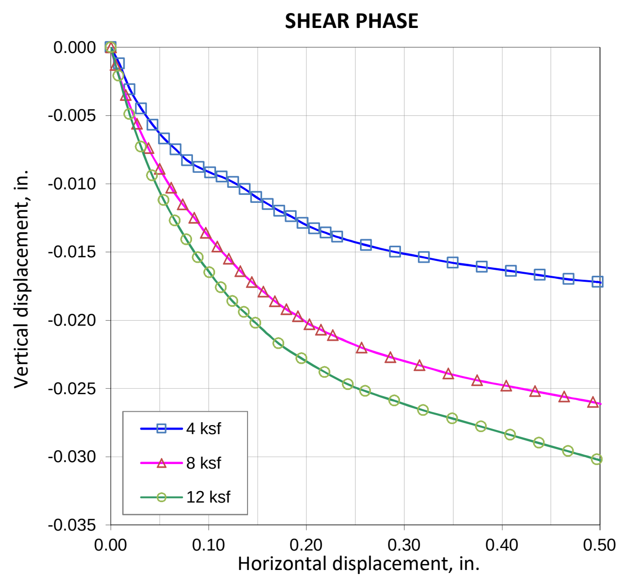
9375 Chillicothe Road, Kirtland, Ohio 44094-8501
p: 440-256-6500, f: 440-256-6500

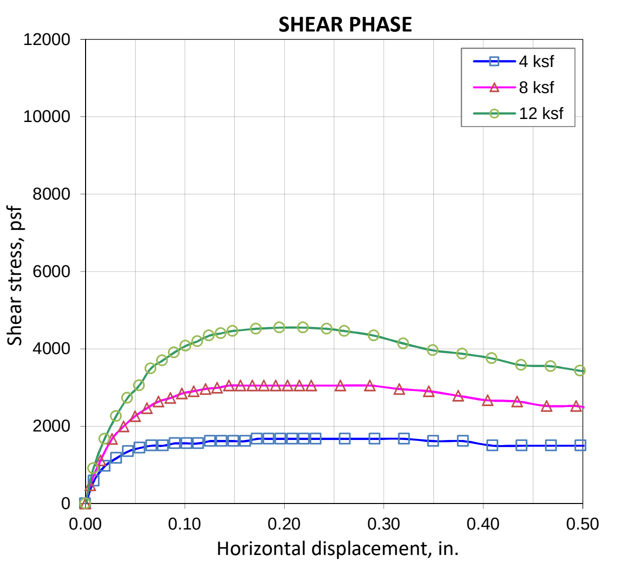
DIRECT SHEAR TEST, ASTM D3080

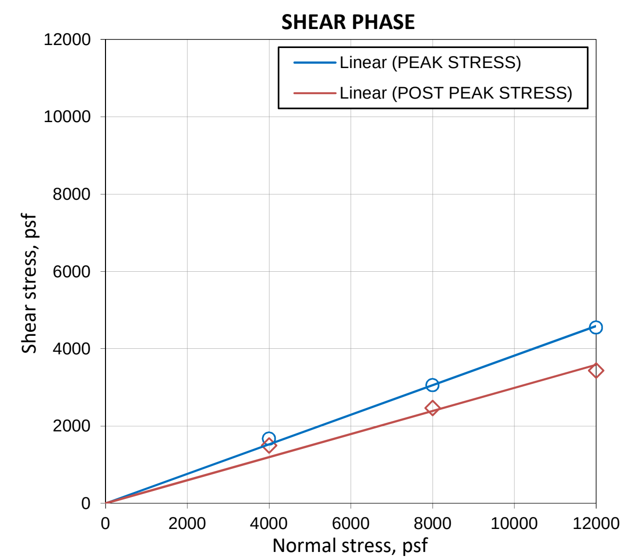
PROJECT: Carter Road Landslide
LOCATION: Cleveland, Ohio
PROJECT #: 076822.27
CLIENT: City of Cleveland
TEST DATE(S): 1/7/2019

SAMPLE #: ST
SAMPLE LOCATION: B-1; 51.5' - 53.5'
SAMPLE DESCRIPTION: Gray LEAN CLAY
SOIL STRUCTURE: Undisturbed
SHEAR DEVICE: Humboldt
TEST CONDITIONS: Shear box saturated
TECHNICIAN: SM









	Sample Parameters		
Normal stress (psf):	4000	8000	12000
Thickness (in):	0.999		
Diameter (in):	2.500		
Dry mass sample (gr):	121.6	121.5	121.2
Initial moisture content (%):	29.5	29.3	30.2
Initial wet density (pcf):	122.0	121.7	122.2
Initial dry density (pcf):	94.2	94.1	93.8
Final moisture content (%):	29.6	28.0	26.4
Final wet density (pcf):	131.4	141.9	147.1
Final dry density (pcf):	101.4	110.9	116.4

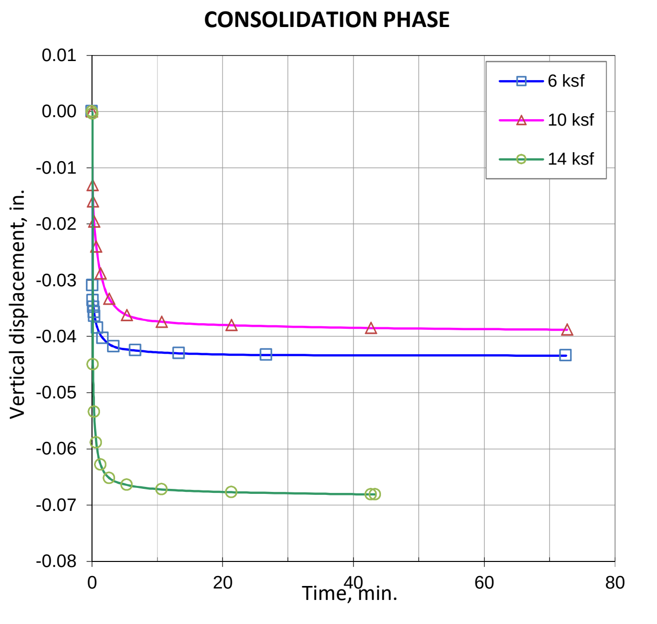
	Test Results		
Normal stress (psf):	4000	8000	12000
	CONSOLIDATION PHASE		
Final vertical displacement (in):	-0.048	-0.116	-0.156
Duration consolidation (min):	44.5	39.5	64.0
	SHEAR PHASE		
Peak Shear Stress (psf):	1672	3051	4547
Horizontal displacement (in):	0.167	0.138	0.177
Post Peak Shear Stress (psf):	1496	2464	3432
Horizontal displacement (in):	0.504	0.505	0.503
Shear rate (mm/min):	0.010	0.010	0.010
Duration of test (min):	1290	1305	1290
Peak:	ϕ (deg)	20.9	16.6
Post Peak:	C (psf)	0	0

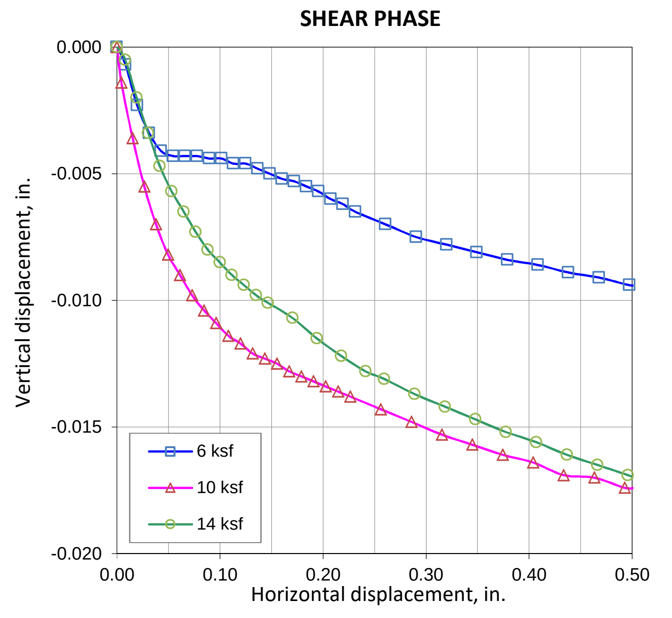
SME
9375 Chillicothe Road, Kirtland, Ohio 44094-8501
p: 440-256-6500, f: 440-256-6500

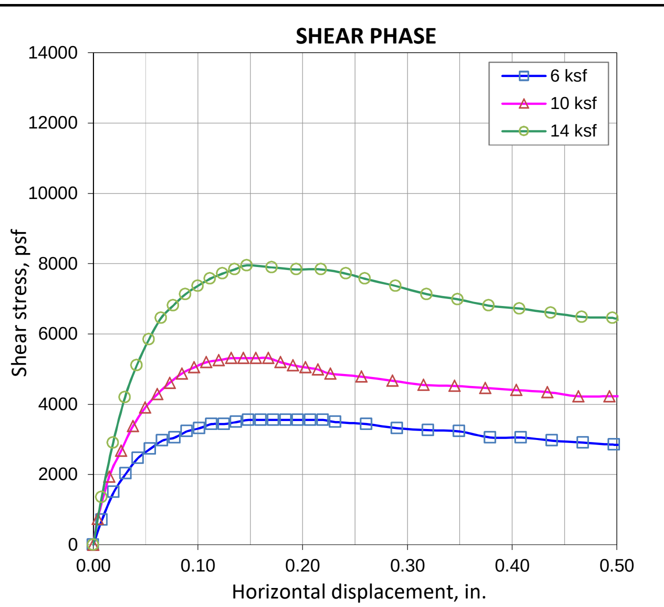
DIRECT SHEAR TEST, ASTM D3080

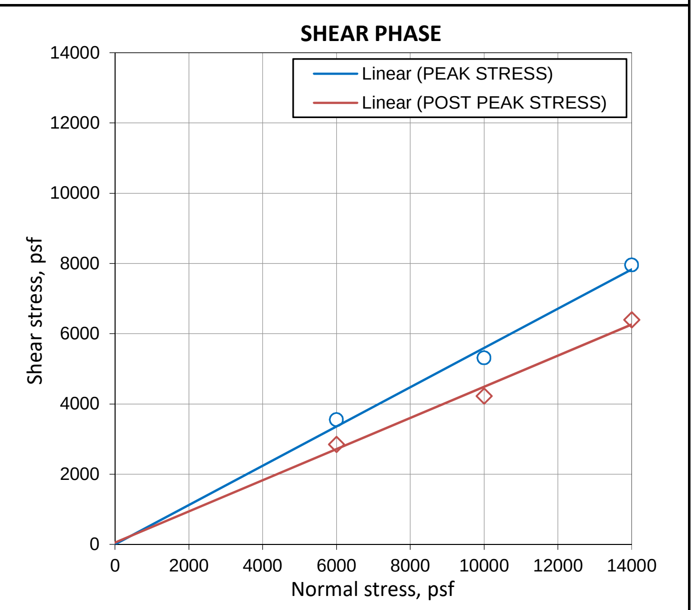
PROJECT: Carter Road Landslide
LOCATION: Cleveland, Ohio
PROJECT #: 076822.27
CLIENT: City of Cleveland
TEST DATE(S): 1/2/2019

SAMPLE #: ST
SAMPLE LOCATION: B-1; 73.5' - 75.5'
SAMPLE DESCRIPTION: Gray LEAN CLAY
SOIL STRUCTURE: Undisturbed
SHEAR DEVICE: Humboldt
TEST CONDITIONS: Shear box saturated
TECHNICIAN: SM





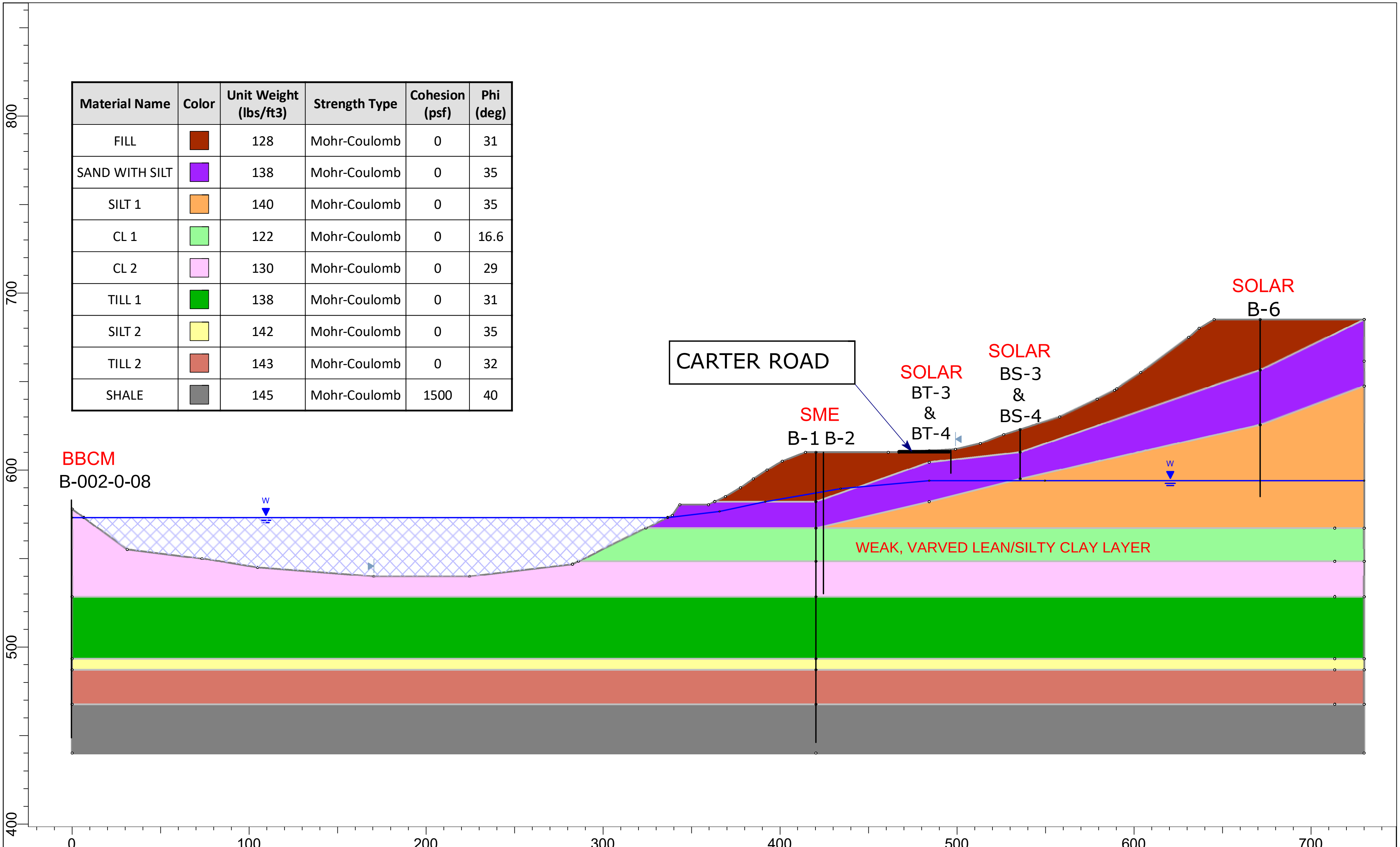




	Sample Parameters		
Normal stress (psf):	6000	10000	14000
Thickness (in):	0.999		
Diameter (in):	2.500		
Dry mass sample (gr):	136.8	138.7	139.2
Initial moisture content (%):	21.8	21.5	21.3
Initial wet density (pcf):	129.0	130.5	130.8
Initial dry density (pcf):	105.9	107.4	107.8
Final moisture content (%):	21.6	21.0	20.9
Final wet density (pcf):	136.8	138.1	143.4
Final dry density (pcf):	112.4	114.2	118.6

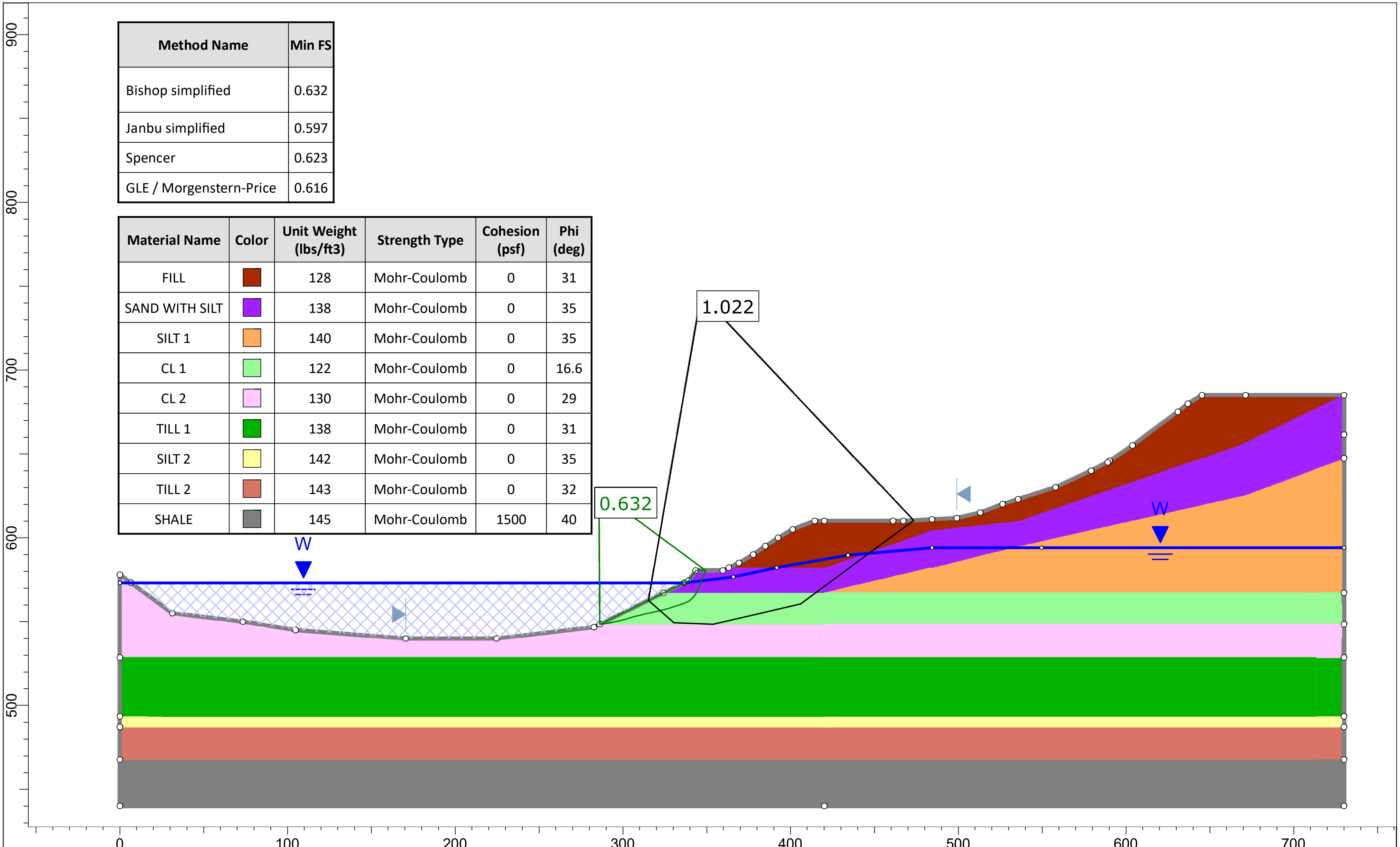
	Test Results		
Normal stress (psf):	6000	10000	14000
	CONSOLIDATION PHASE		
Final vertical displacement (in):	-0.043	-0.039	-0.068
Duration consolidation (min):	72.5	72.7	43.3
	SHEAR PHASE		
Peak Shear Stress (psf):	3550	5310	7950
Horizontal displacement (in):	0.143	0.126	0.147
Post Peak Shear Stress (psf):	2846	4225	6396
Horizontal displacement (in):	0.503	0.505	0.502
Shear rate (mm/min):	0.010	0.010	0.010
Duration of test (min):	1290	1305	1290
Peak:	ϕ (deg)	29.2	24.1
Post Peak:	C (psf)	0	0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FILL		128	Mohr-Coulomb	0	31
SAND WITH SILT		138	Mohr-Coulomb	0	35
SILT 1		140	Mohr-Coulomb	0	35
CL 1		122	Mohr-Coulomb	0	16.6
CL 2		130	Mohr-Coulomb	0	29
TILL 1		138	Mohr-Coulomb	0	31
SILT 2		142	Mohr-Coulomb	0	35
TILL 2		143	Mohr-Coulomb	0	32
SHALE		145	Mohr-Coulomb	1500	40



SLIDE 8.016

Project	076822.27_Carter Road Slope
Analysis	Slope Profile
Author Jalal Fatemi	*Company* SME
Date 1/31/2019, 5:27:24 PM	*File Name* 076822.27.slmd



Method Name	Min FS
Bishop simplified	0.632
Janbu simplified	0.597
Spencer	0.623
GLE / Morgenstern-Price	0.616

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FILL		128	Mohr-Coulomb	0	31
SAND WITH SILT		138	Mohr-Coulomb	0	35
SILT 1		140	Mohr-Coulomb	0	35
CL 1		122	Mohr-Coulomb	0	16.6
CL 2		130	Mohr-Coulomb	0	29
TILL 1		138	Mohr-Coulomb	0	31
SILT 2		142	Mohr-Coulomb	0	35
TILL 2		143	Mohr-Coulomb	0	32
SHALE		145	Mohr-Coulomb	1500	40

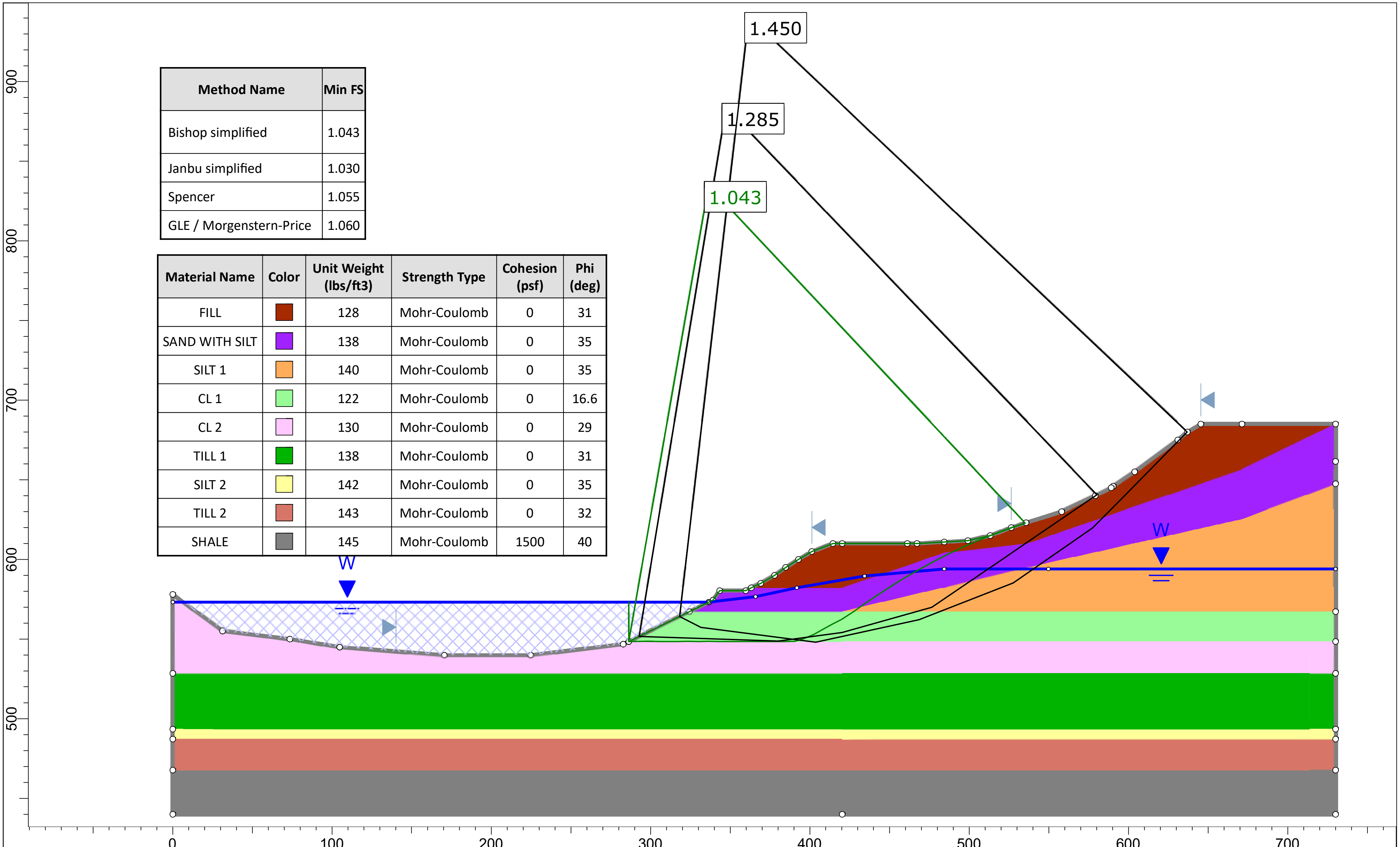
SME

SLIDEINTERPRET 8.016

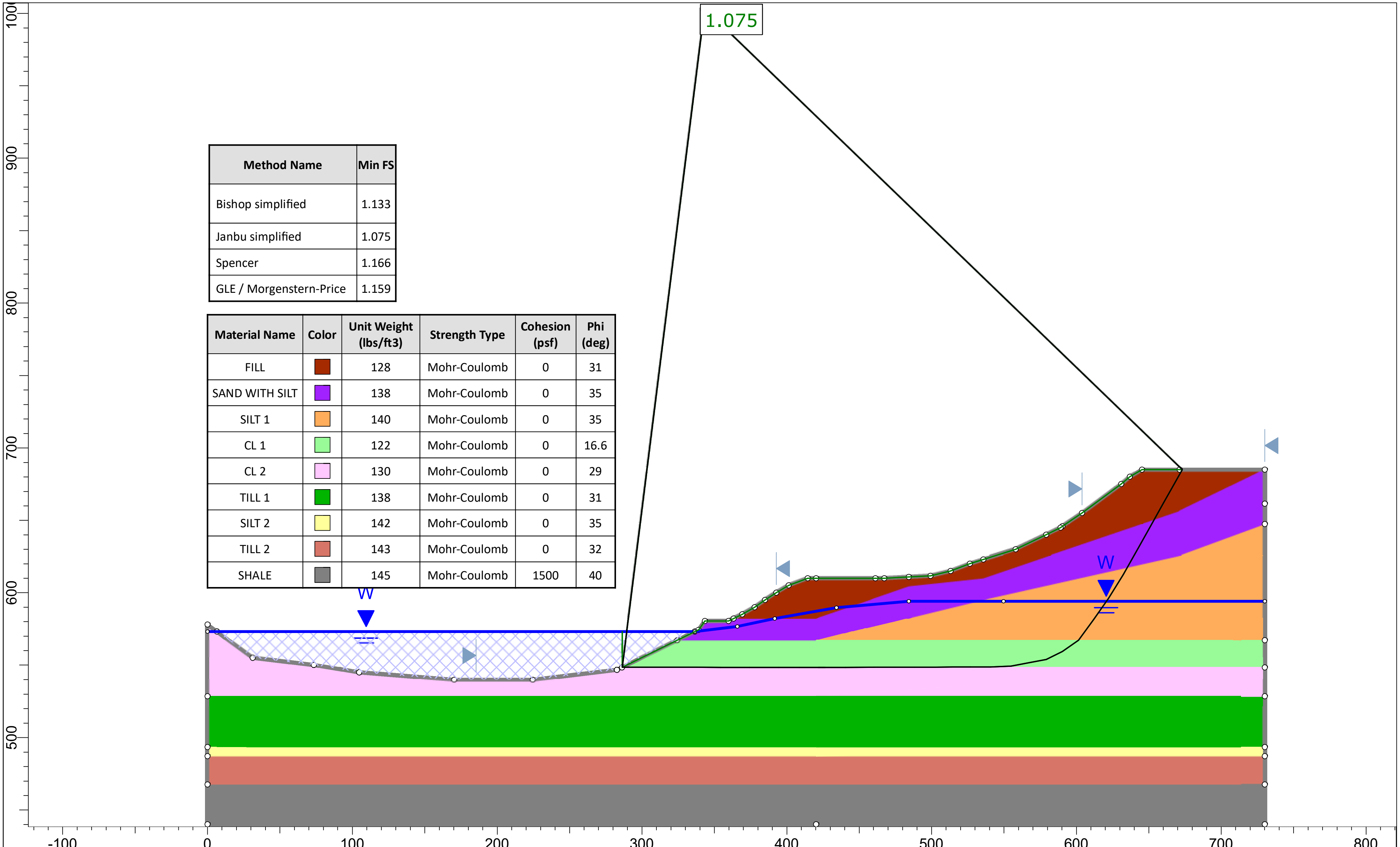
Project	076822.27_Carter Road		
Analysis Description	Down Slope_Non-circular		
Drawn By	JF	*Scale*	1:950
Company	SME		
Date	2/13/2019 12:18:35 PM	*File Name*	076822.27.slmd

Method Name	Min FS
Bishop simplified	1.043
Janbu simplified	1.030
Spencer	1.055
GLE / Morgenstern-Price	1.060

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FILL		128	Mohr-Coulomb	0	31
SAND WITH SILT		138	Mohr-Coulomb	0	35
SILT 1		140	Mohr-Coulomb	0	35
CL 1		122	Mohr-Coulomb	0	16.6
CL 2		130	Mohr-Coulomb	0	29
TILL 1		138	Mohr-Coulomb	0	31
SILT 2		142	Mohr-Coulomb	0	35
TILL 2		143	Mohr-Coulomb	0	32
SHALE		145	Mohr-Coulomb	1500	40



SME	Project	076822.27_Carter Road	
	Analysis Description	Mid Slope_Non-circular	
	Drawn By: JF	Scale: 1:1000	Company: SME
SLIDEINTERPRET 8.016	Date: 2/13/2019 12:15:50 PM		File Name: 076822.27.slmd



Method Name	Min FS
Bishop simplified	1.133
Janbu simplified	1.075
Spencer	1.166
GLE / Morgenstern-Price	1.159

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FILL		128	Mohr-Coulomb	0	31
SAND WITH SILT		138	Mohr-Coulomb	0	35
SILT 1		140	Mohr-Coulomb	0	35
CL 1		122	Mohr-Coulomb	0	16.6
CL 2		130	Mohr-Coulomb	0	29
TILL 1		138	Mohr-Coulomb	0	31
SILT 2		142	Mohr-Coulomb	0	35
TILL 2		143	Mohr-Coulomb	0	32
SHALE		145	Mohr-Coulomb	1500	40

SME

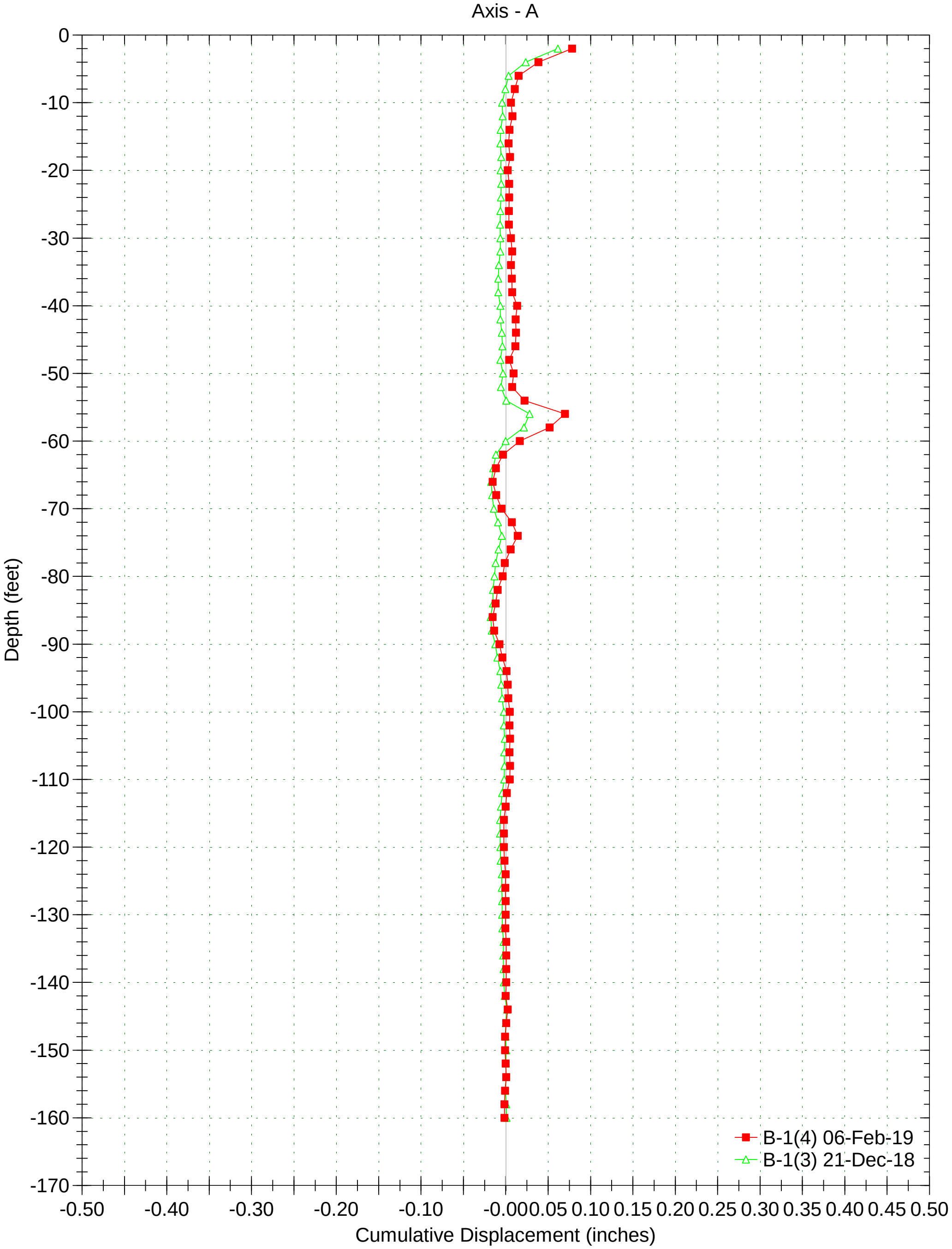
SLIDEINTERPRET 8.016

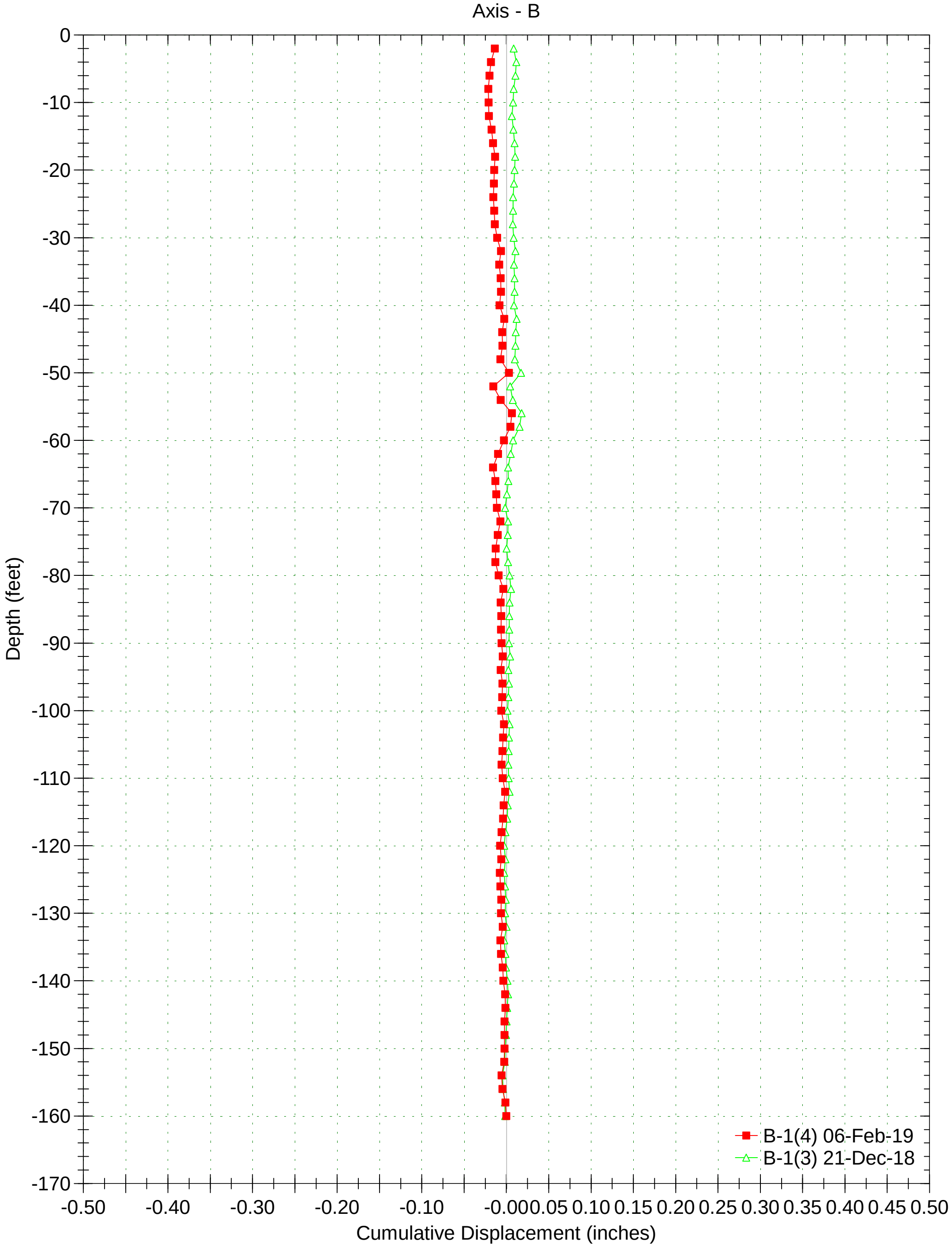
Project	076822.27_Carter Road		
Analysis Description	Top Slope_Non-circular		
Drawn By	JF	*Scale* 1:1100	*Company* SME
Date	2/13/2019 12:11:57 PM	*File Name*	076822.27.slmd

RST Instruments Ltd. CUMULATIVE DISPLACEMENT Inclinalysis v. 2.48.7

Borehole : B-1
Project : 076822.27_Carter Road Slope Failure
Location : Cleveland, OH
Northing : 664603.7174
Easting : 2187952.388
Collar :

Spiral Correction : N/A
Collar Elevation : 0.00 feet
Reading Depth : 160.0 feet
A+ Groove Azimuth :
Base Reading : 2018 Dec 07 14:19
Applied Azimuth : 0.0 degrees





APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT
GENERAL COMMENTS

Important Information about This
Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

Passionate People Building
and Revitalizing our World

SME